An Integrated Safety Presentation -

"Where we are and where we need to be"

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August 16, 2000

Briefing Contents

- Operational Safety
- Research for Safety
  - Fixing Today's Safety Problems
  - Discovering Tomorrow's Safety Problems
- Design for Safety
- Coordination, cooperation, partnerships
- Future opportunities
- Closing observations and comments

Operational Safety

Agency Safety Initiative

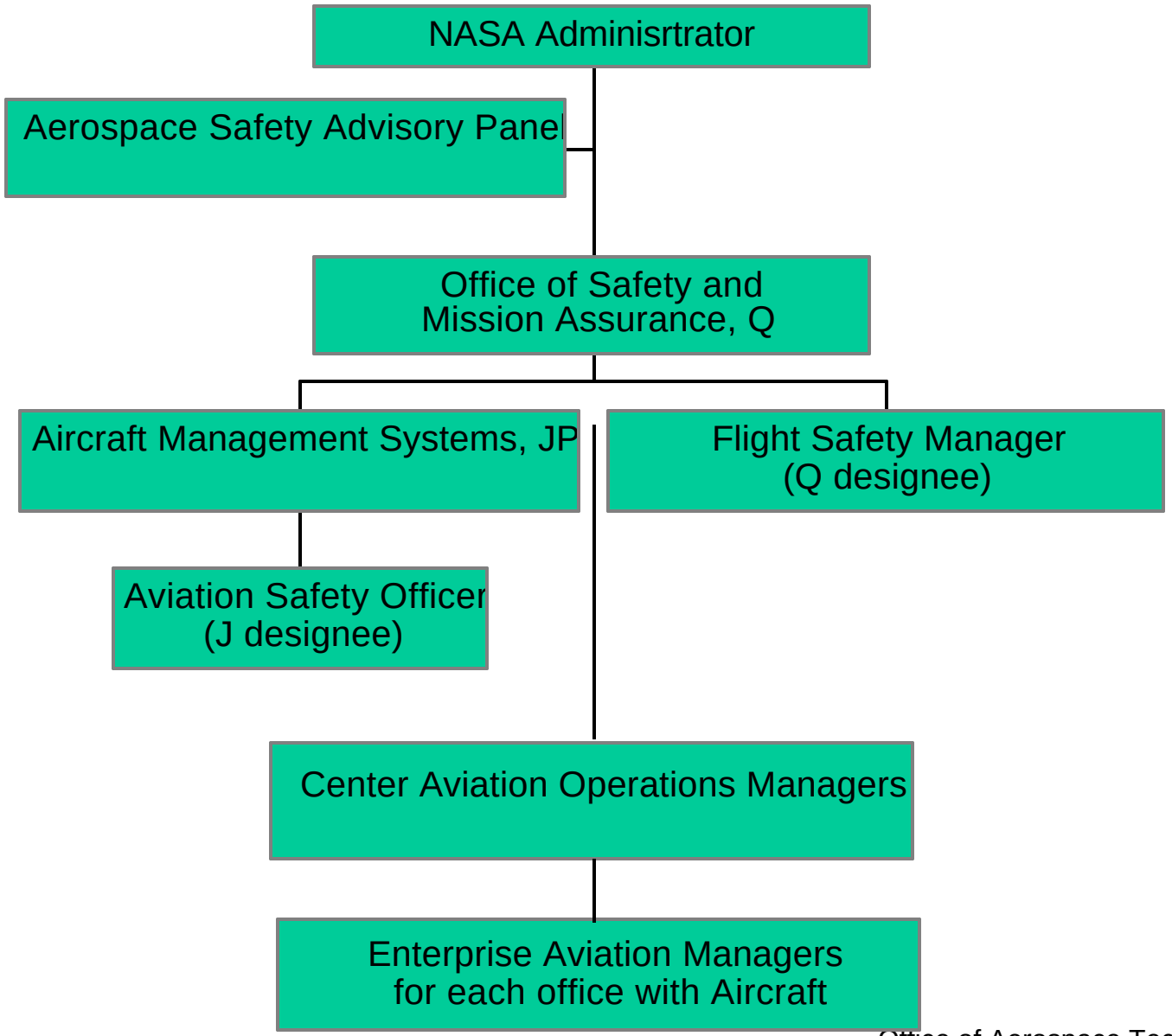
"Mission Success Starts with Safety"

The Agency Safety Initiative establishes the NASA safety priority

- First, safety for the public
- Second, safety for astronauts and pilots
- Third, safety for employees
- Fourth, safety for high value equipment

http://www.hq.nasa.gov/office/codeq/safety/index.htm

Operational Safety Hierarchy



NASA Safety Manual/Aircraft Operations Management

NASA Procedures & Guidance - 8715.3 &7900.3A

- Aviation Safety Responsibilities
  - Administrator is senior person responsible for safety
  - AA/Q sets safety program requirements, provides support, and oversight
  - Flight Safety Manager, designated by Code Q, *next slide*
  - AA/J responsible for management of NASA Aircraft
  - Aviation Safety Officer, designated by Code J, *next slide*
  - Aerospace Advisory Panel *on second next slide*
  - Center Director is responsible for the safe operation of assigned aircraft
  - Center Aviation Manager is responsible for operations
  - Center Aviation Safety Officer is the focal point for safety education, advise and oversight
  - Pilot-in-Command responsible for safety of operation & passenger safety

http://nodis.hq.nasa.gov/Library/Directives/NASA-WIDE/Procedures/contents.html

Flight Safety Manager/Aviation Safety Officer,

- The Flight Safety Manager(Q) is responsible for the oversight of NASA Aviation Safety Program
- The Aviation Safety Officer(J) is responsible for
  - developing and implementing NASA aviation safety policy
  - providing guidance for aircraft safety, operations, maintenance, & training
  - provides technical and operational assistance for improving component aviation safety programs

Aerospace Safety Advisory Panel (ASAP)

ASAP Mission: to advise the NASA Administrator and Congress on all safety-related issues--design, development, manufacturing, flight preparation, and missions operations--concerning NASA's human space flight programs.

http://www.hq.nasa.gov/office/codeq/codeq-1.htm#mission

Space Flight, Code M

Human Exploration and Development of Space

Goals

•Prepare to conduct human missions of exploration to planetary and other bodies in the solar system;

•Use the environment of space to expand scientific knowledge;

•Provide safe and affordable human access to space, establish a human presence in space, and share the human experience of being in space;

•Enable the commercial development of space and share HEDS knowledge, technologies, and assets that promise to enhance the quality of life on Earth.

http://www.hq.nasa.gov/office/nsp/heds.htm

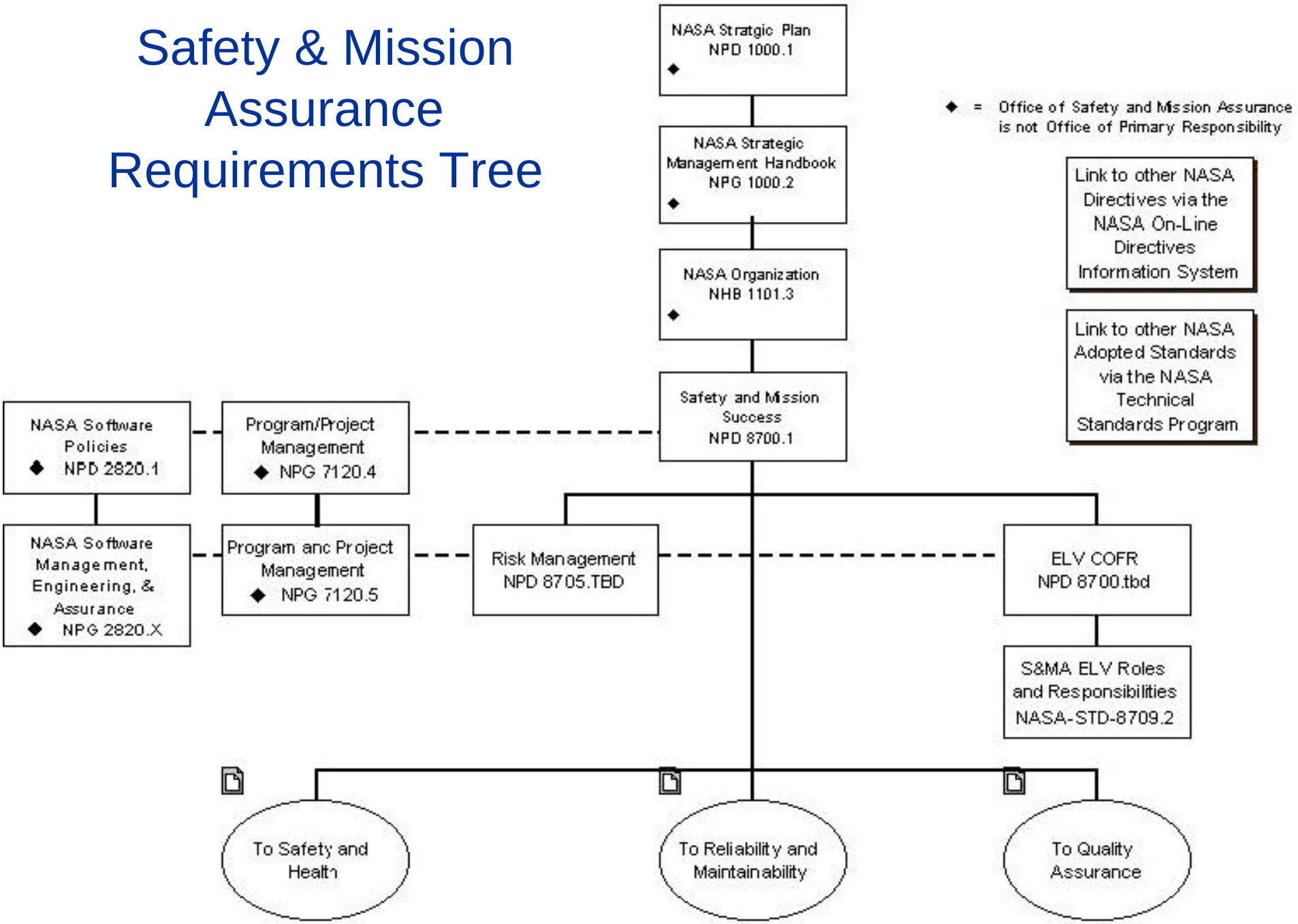
Office of Safety & Mission Assurance(OSMA), Code Q,

"OSMA assures the safety and enhances the success of all NASA activities through the development, implementation, and oversight of Agency wide safety, reliability, maintainability, and quality assurance policies and procedures."

- Assures Safety and Mission Success through
  - Risk Management
  - Failure Modes and Effects Analysis
  - Fault Tree Analysis

http://www.hq.nasa.gov/office/codeq/

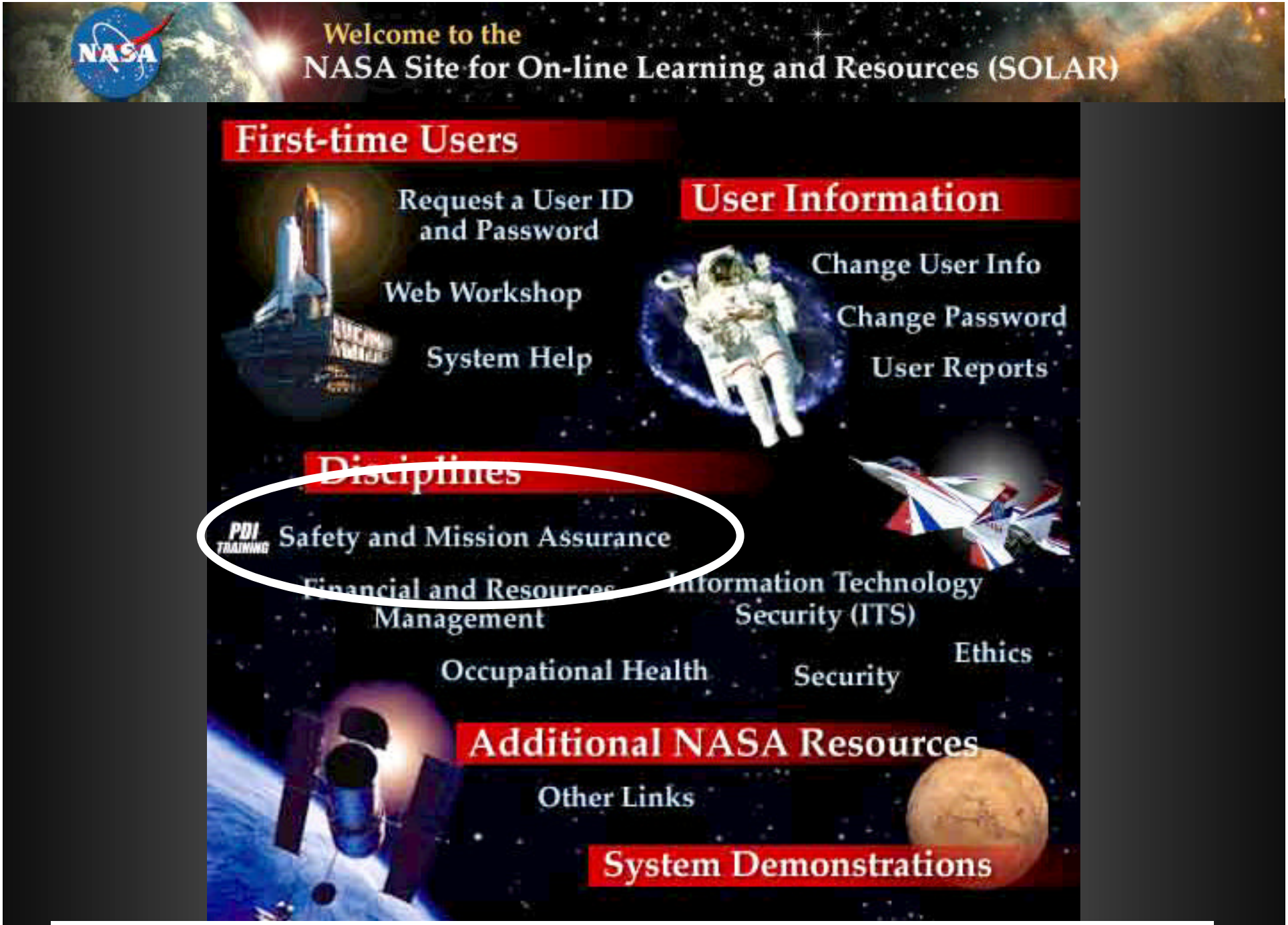
Safety & Mission Assurance Requirements Tree



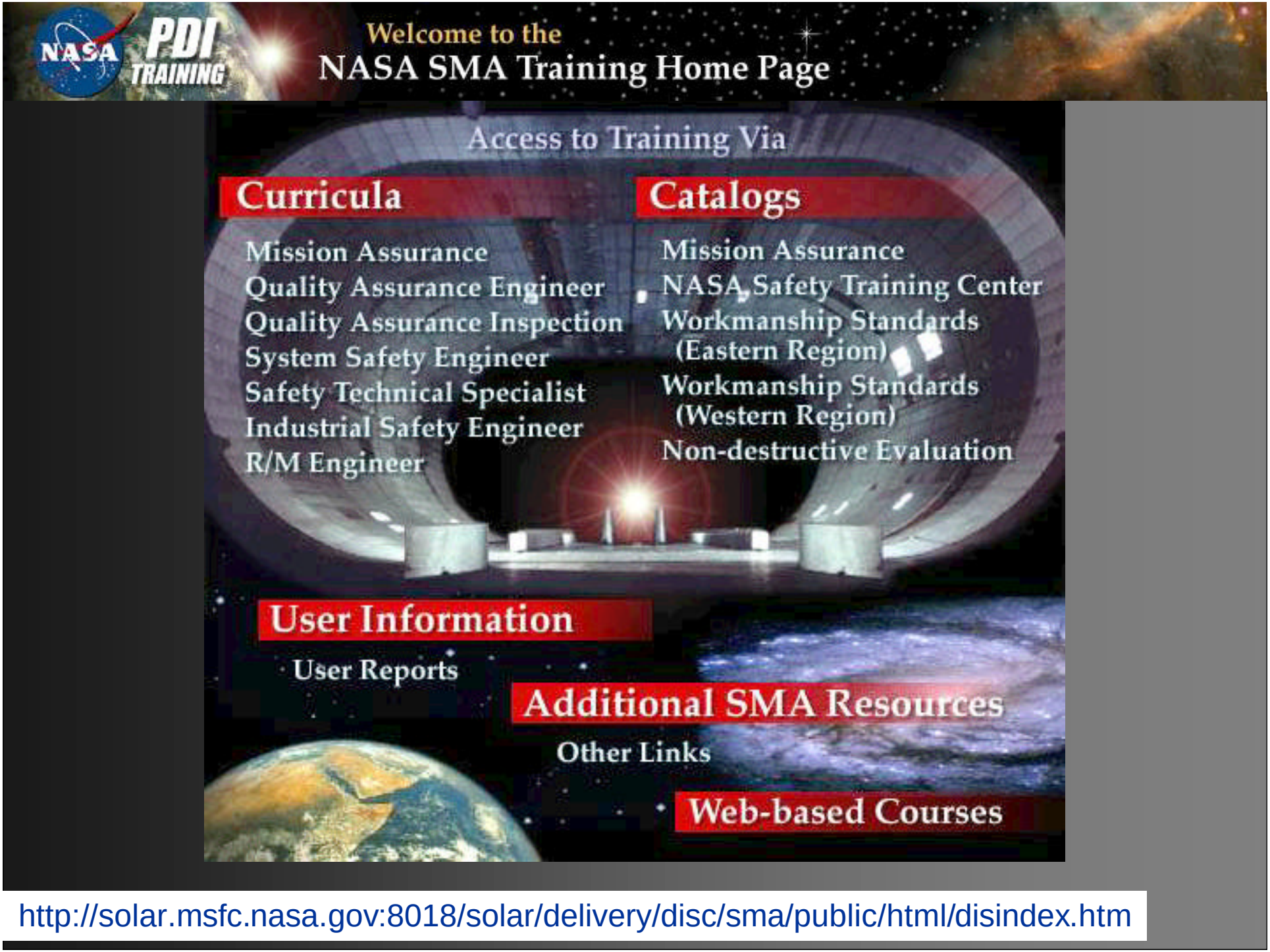
http://www.hq.nasa.gov/office/codeq/doctree/qdoc.htm

Inter-center Aircraft Operations Panel

- Purpose
  - To ensure safe and efficient flight operations
  - To provide an overview of the general health of all aspects of aircraft operations
- Participants
  - Aircraft Management Office (J)
  - Flight Safety Manager (Q)
  - Aviation Safety Officer (J)
  - Center Aviation Operations Managers
  - Enterprise Aviation Managers
  - Center Maintenance Managers



http://solar.msfc.nasa.gov:8018/solar/delivery/public/html/newindex.htm



http://solar.msfc.nasa.gov:8018/solar/delivery/disc/sma/public/html/disindex.htm

Operational Safety Interaction

- The melding of NASA's operational safety experience with the experience of the aviation community at large elevated the initial starting point of the aviation safety program
- The risk assessment tools developed and implemented by Code Q are complementing the systems analysis assessment of the aviation safety program

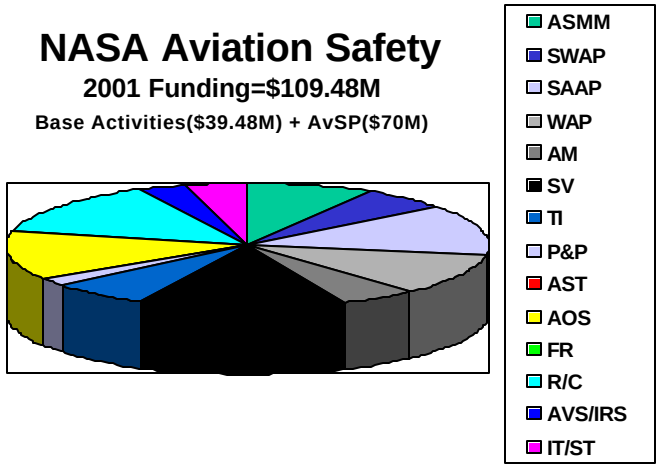
Research for Safety

Fixing Known Safety Problems

Discovering New Safety Issues

Fixing Known Safety Problems

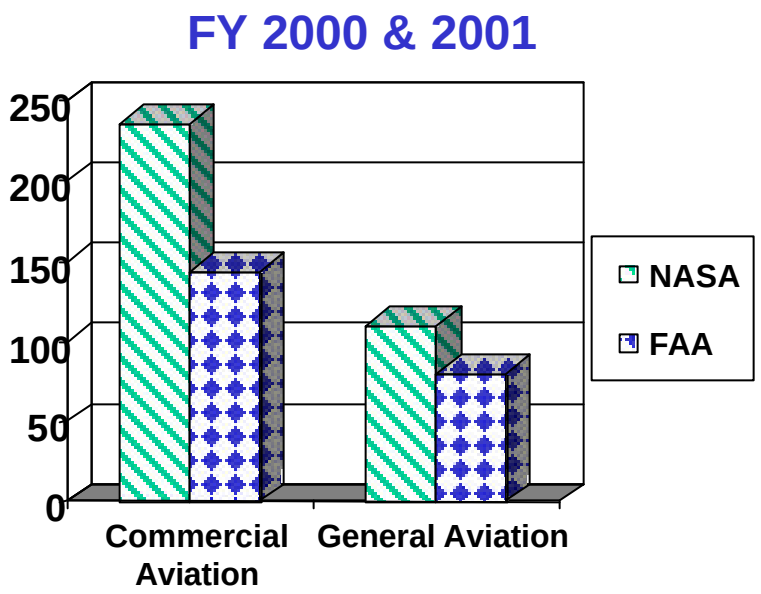
- AvSP (Focused) $70M
  - Aviation System Monitoring & Modeling
  - System-Wide Accident Prevention
  - Single Aircraft Accident Prevention
  - Weather Accident Prevention
  - Accident Mitigation
  - Synthetic Vision



- Safety Base $39.5M
  - Propulsion & Power
  - Advanced Space Transportation
  - Aerospace Operations Systems
  - Flight Research
  - Rotorcraft
  - Aerospace Vehicle Systems
  - Information Technology
- Capacity
  - Aircraft Vortex Spacing
  - Airborne Information for Lateral Spacing
  - Roll Out Turn Off
  - …

FAA Safety Research

- AVIATION SAFETY RISK ANALYSIS
- FIRE RESEACH AND SAFETY
- STRUCTURAL SAFETY
- ADVANCE MATERIALS STRUCTURES
- PROPULSION AND FUEL SYSTEMS
- FLIGHT SAFETY
- ATMOSPHERIC HAZARDS
- AGING AIRCRAFT RESEARCH AND DEVELOPMENT
- AIRCRAFT CATASTROPHIC FAILURE PREVENTION



DoD Safety Research

- AV-8B Harrier Mishap Reduction Program
- Flying Qualities and Flight Control Technology
- Materials Technology
- Tactical Weather Sensors/Systems
- Adaptive Cockpit Hazard Monitoring SBIR
- Bird strike Prevention/Survival
- Fly-by-Light Advanced System Hardware
- Aging Aircraft
- Active Control Technology
- Rotorcraft Pilot's Associate
- Advanced Display Technology
- Visual Information Processing and Displays
- Design Parameters for Visually-Coupled Helmet Mounted Tracker/Display Systems
- Field Emission Display Cockpit Technology
- Cockpit Voice Integration
- …

NASA AvSP Focused Research Projects, 1 of 3

2.1 Aviation System Monitoring & Modeling
- 2.1.1 Intramural Monitoring
- 2.1.2 Extramural Monitoring
- 2.1.3 Modeling & Simulation
- 2.1.4 Data Analysis Tools Development
- 2.1.5 Information Sharing

2.2 System-Wide Accident Prevention
- 2.2.1 Human Error Modeling
- 2.2.2 Maintenance Human Factors
- 2.2.3 Training

http://www.aero-space.nasa.gov/goals/asppocs.pdf

NASA AvSP Focused Research Projects, 2 of 3

2.3 Single Aircraft Accident Prevention

- 2.3.1 Health Management & Flight Critical System Design
- 2.3.2 Propulsion Health Management
- 2.3.3 Control Upset Management

2.4 Weather Accident Prevention

- 2.4.1 Aviation Weather Information Distribution & Presentation
- 2.4.2 Communication Link
- 2.4.3 Turbulence Detection & Mitigation

NASA AvSP Focused Research Projects 3 of 3

2.5 Accident Mitigation
- 2.5.1 Systems Approach to Crashworthiness
- 2.5.2 Fire Prevention

2.6 Synthetic Vision
- 2.6.1 Commercial & Business Aircraft
- 2.6.2 General Aviation & Rotorcraft
- 2.6.3 Enabling Technologies

NASA Tech Base Safety Research Projects - FY-2000, 1 of 3

- Aerospace Operations
  - Human-Automation Integration Research
  - Cost-benefit Operational Safety Testing Models
  - Human Error Countermeasures
  - Psycho/Physiological Stressors & Factors
  - Aircraft Icing
- Aerospace Propulsion & Power
  - Ultra Safe Propulsion

NASA Tech Base Safety Research Projects - FY-2000, 2 of 3

Rotor Craft

- Safe All Weather Operations for Rotorcraft
- Fast Response for Industry Requests

Flight Research

- *None*

Information Technology

- Intelligent Systems Controls & Technology
- Software Integrity, Productivity and Security

NASA Tech Base Safety Research Projects - FY-2000, 3 of 3

Aerospace Vehicle Systems

- Inherently Reliable Systems

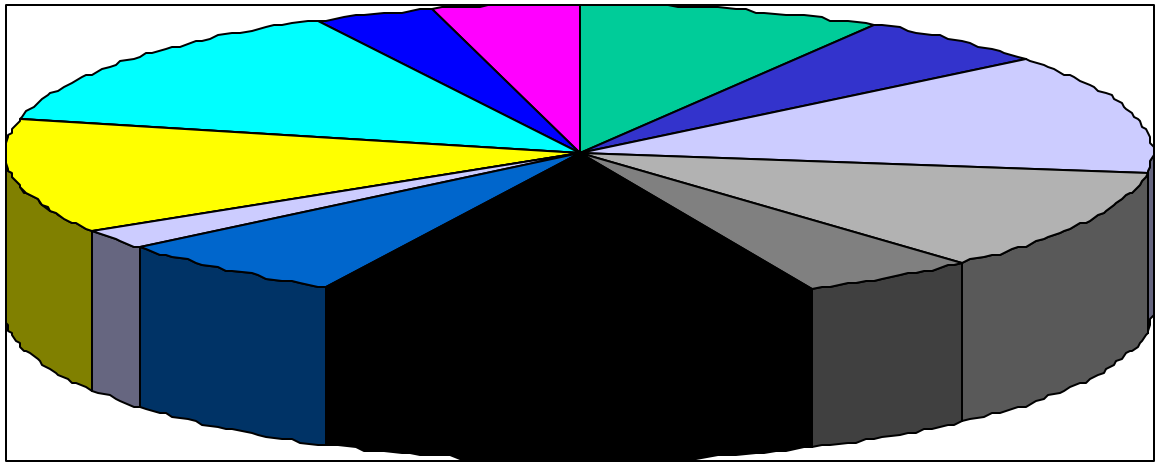
Advanced Space Transportation

- *None*

NASA Aviation Safety

2001 Funding=$109.48M

Base Activities($39.48M) + AvSP($70M)



ASMM
SWAP
SAAP
WAP
AM
SV
TI
P&P
AST
AOS
FR
R/C
AVS/IRS
IT/ST

AvSP

Base

NASA Capacity Program Safety Research Projects, 1 of 2

- Aircraft Vortex Spacing System reduces the in-trail spacing without compromising safety
- Airborne Information for Lateral Spacing reduces lateral spacing on simultaneous approaches to closely spaced parallel runways without compromising safety
- Roll Out Turn Off provides the pilot with a computer-generated HUD “picture” on where to start and end braking, and exactly on which taxiway to exit

NASA Capacity Program Safety Research Projects, 2 of 2

- Electronic Moving Map display
  - provides a view of the entire airport -- main runways, taxiways, stub runways, towers, all aircraft
  - provides all clearances to the pilot in easy-to-understand pictorial format
- CTAS-FMS integration
  - provides improved accuracy in predicting aircraft trajectories
  - shares the information with controllers and the aircraft's flight computer

FAA Safety Research Project Description - FY-2000, 1 of 2

RPD #	TITLE
	AVIATION SAFETY RISK ANALYSIS
• 460a	Risk Analysis Decision Support
• 460b	A/C Maintenance: Maintainability & Reliability
• 460c	Safety Analysis Methodology
	FIRE RESEACH AND SAFETY
• 517	Fire Resistant Materials
• 558	Aircraft Fire Safety and Cabin Safety
	STRUCTURAL SAFETY
• 502	Aircraft Crashworthiness
• 519	Rotorcraft Structural Integrity and Safety Issues
	ADVANCE MATERIALS STRUCTURES
• 504	Advanced Materials
	PROPULSION AND FUEL SYSTEMS
• 419	Turbine Engine Research
• 564	Fuels and Fuels Systems Resear

FAA Safety Research Project Description - FY-2000, 2 of 2

FLIGHT SAFETY

- 560 Flight Controls and Digital Avionics System

ATMOSPHERIC HAZARDS

- 557 Aircraft Icing
- 559 Electromagnetic Hazards to Aircraft

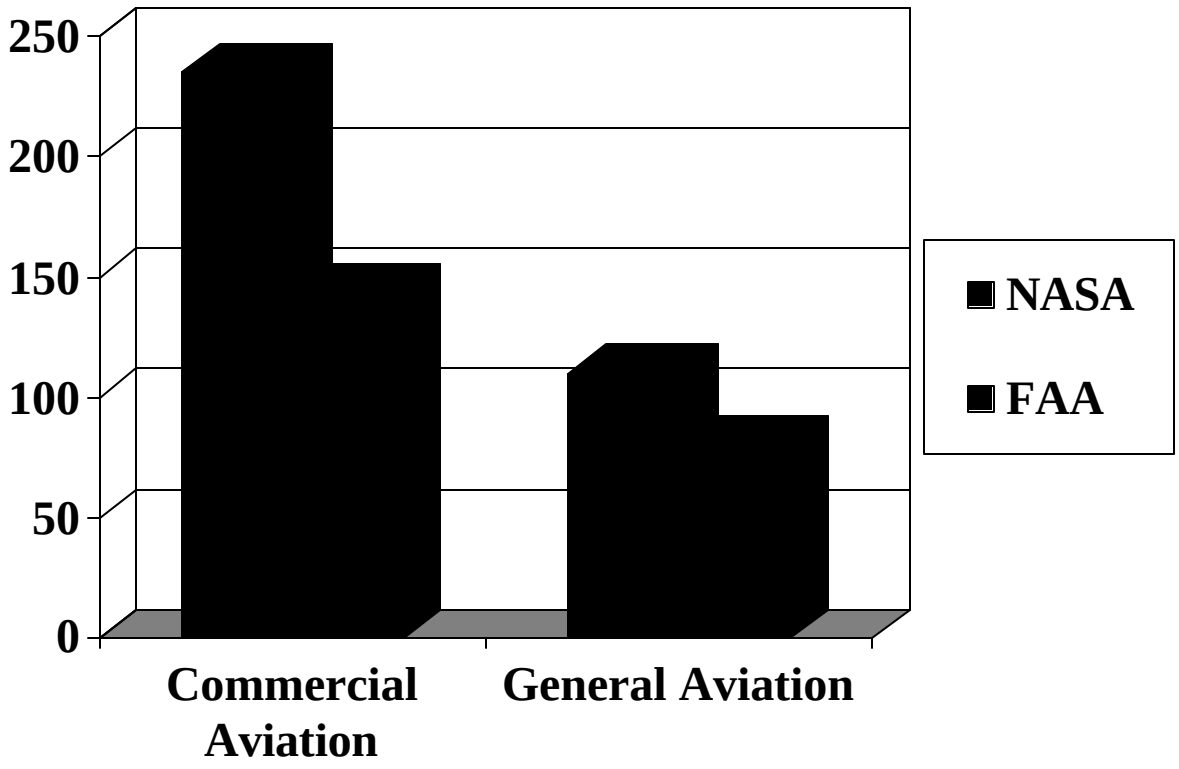
AGING AIRCRAFT RESEARCH AND DEVELOPMENT

- 161 Structural Integrity of Commuters
- 556 Continued Airworthiness of Aircraft Engines
- 515 Structural Response Simulation and Modeling
- 510 Airborne Data Monitoring System
- 672 Aging Mechanical Systems
- 673 Aging Electrical Systems
- 519 Rotorcraft Structural Integrity and Safety Issues
- 584 Inspection Systems R&D

AIRCRAFT CATASTROPHIC FAILURE PREVENTION

- 516 Catastrophic Failure Prevention

Relative Safety Investments
FY 2000 & 2001



ref: FAA-NASA Integrated Safety Research Plan, July 2000,Figure 8

DoD Aviation Safety Research Projects, 1 of 5

AV-8B Harrier Mishap Reduction Program

- An initiative to reduce the potential for near-term loss of Marines and aircraft initially focusing on the identification substantive means to significantly reduce the AV-8B mishap rate and enhance community confidence in their aircraft.

Flying Qualities and Flight Control Technology

- Transport Class Nonlinear PIO In-Flight Simulation
- C-17 Test Aircraft (T1) PIO Data Flights
- Automated Rating Technique (ART) based on measured pilot psycho-physiological

http://www.aero-space.nasa.gov/library/dod.htm

DoD Aviation Safety Research Projects, 2 of 5

Flying Qualities and Flight Control Technology, cont.

- Transport Class Nonlinear PIO In-Flight Simulation
- C-17 Test Aircraft (T1) PIO Data Flights
- Automated Rating Technique (ART) based on measured pilot psycho-physiological
- **Incorporation of interim PIO requirements** in both the flying qualities integrity program, and the Standard Evaluation Maneuver Set
- Developmental and operational **flight safety will be enhanced** for both military and civilian aircraft due to effective new PIO design requirements and evaluation techniques contained in the revised specification.
- Passive Terrain Estimation Sensor Studies:
- Nonlinear Outer Loop Control of Naval Aircraft:
- Vectoring for Extremely Short Takeoff and Landing Control and Tailless Operational Research:

DoD Aviation Safety Research Projects, 3 of 5

Materials Technology

- Development of small, low cost sensors to monitor and record corrosivity.
- Demonstration of a mobile, automated scanner to inspect bonded honeycomb, composite and metallic components.
- Development of "smart structures" for improved dynamic control of complex systems such as helicopters, or stability augmentation of high frequency structural modes.
- Development of environmentally benign materials such as corrosion resistant alloys, coatings, and lubricants.

DoD Aviation Safety Research Projects, 4 of 5

- Tactical Weather Sensors/Systems
- Adaptive Cockpit Hazard Monitoring SBIR
- Bird strike Prevention/Survival
- Fly-by-Light Advanced System Hardware
- Aging Aircraft
- Active Control Technology
- Rotorcraft Pilot's Associate

DoD Aviation Safety Research Projects, 5 of 5

- Advanced Display Technology
- Visual Information Processing and Displays
- Design Parameters for Visually-Coupled Helmet Mounted Tracker/Display Systems
- Field Emission Display Cockpit Technology
- Cockpit Voice Integration
- Real-time Information in the Cockpit
- Flight Display Integration
- Adaptive Interface Technology

Research for Safety

Fixing Today's Safety Problems

Discovering Tomorrow's Safety Problems

Discovering Tomorrow's Safety Problems

- Aviation Systems Monitoring and Modeling, +
  - Future Flight Data Collection Committee, sponsored by NTSB/FAA
  - Increase required data rates from 2-4Hz to16-32 Hz
  - Cockpit Video Recording (CVR) is being explored
  - APMS/FOQA/PDARS
  - ASRS/GAIN/NAOMS/ASAP

Improving Flight Data

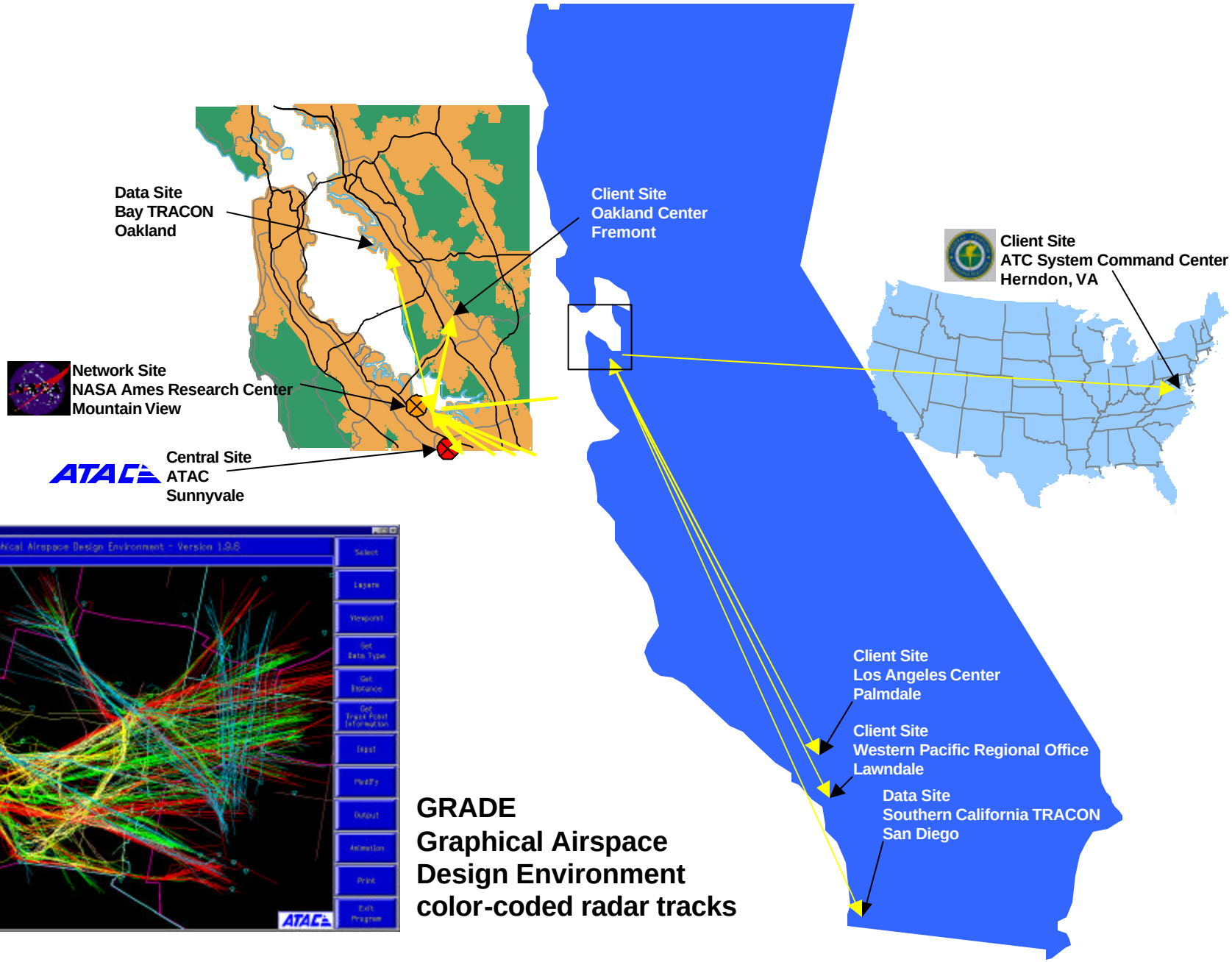
- Cockpit Video Recording (CVR) is being examined
  - Cockpit visibility
  - Glass cockpit display information
  - With “blanking” and encryption to protect privacy / security concerns
- Increase required data rates from 2-4Hz to16-32 Hz, http://www.aero-space.nasa.gov/library/datarate.pdf
  - For inputs to the primary cockpit controls
  - For the outputs to the primary flight control surfaces
- Future Flight Data Collection Committee, sponsored by NTSB & FAA, RTCAhttp://www.aero-space.nasa.gov/goals/asppocs.pdf

Improving & Expanding Flight Data Collection & Analysis

- APMS/FOQA/PDARS
  - NASA's Aircraft Parameter Monitoring System is providing data analysis tools and precursor candidates
  - FAA's Flight Operations Quality Assurance initiative will benefit from APMS products
  - Performance Data Analysis and Reporting System

PDARS Prototype System Demonstration

GRADE
Graphical Airspace Design Environment
color-coded radar tracks



Improving & Expanding Anecdotal Data Collection & Analysis

ASRS/GAIN/NAOMS/ASAP

- Aviation Safety Reporting System
  http://asrs.arc.nasa.gov
- Global Aviation Information Network
  http://www.gainweb.org
- National Aviation Operations Monitoring Service
- Aviation Safety Action Program - an ALPA initiative sanctioned by FAA
  http://www.alpa.org/internet/alp/marasap.htm

Recent Response to ASRS

FYI of July 28, 2000
3:29 PM

Subject: RE: RAMP ILLUMINATION
Date: Thu, 3 Aug 2000 09:36:45 -0400

In response to the ASRS, The Port Authority of NY and NJ ordered American Airlines to adjust its temporary light fixtures (that serve to illuminate a construction site) so that exposure to pilots of taxiing aircraft is minimized. The Port Authority Aeronautical Services unit will continue to monitor the situation as necessary.

Thomas L. Bosco
Manager
Aeronautical Services
John F. Kennedy International Airport
The Port Authority of NY and NJ

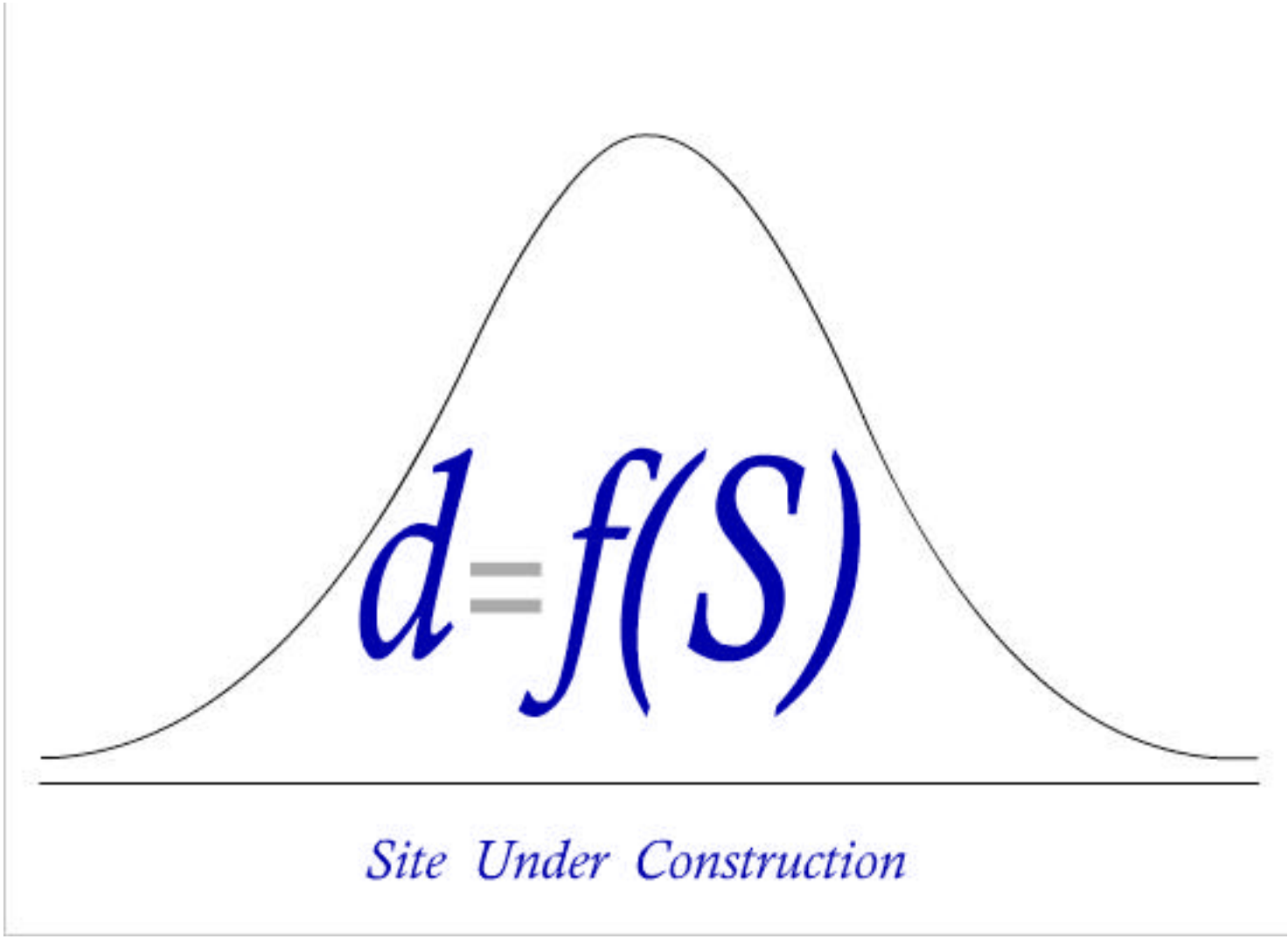
Error Management Training (EMT)

- Linking Line Operational Safety Audits (LOSA) to Flight Operations Quality Assurance
- Both ICAO and IATA are studying cockpit audits
- LOSA will be focal point for ICAO's Flight & Human Factors Program, 2000-04

AvWk, July 17, 2000, p 61

Design for Safety

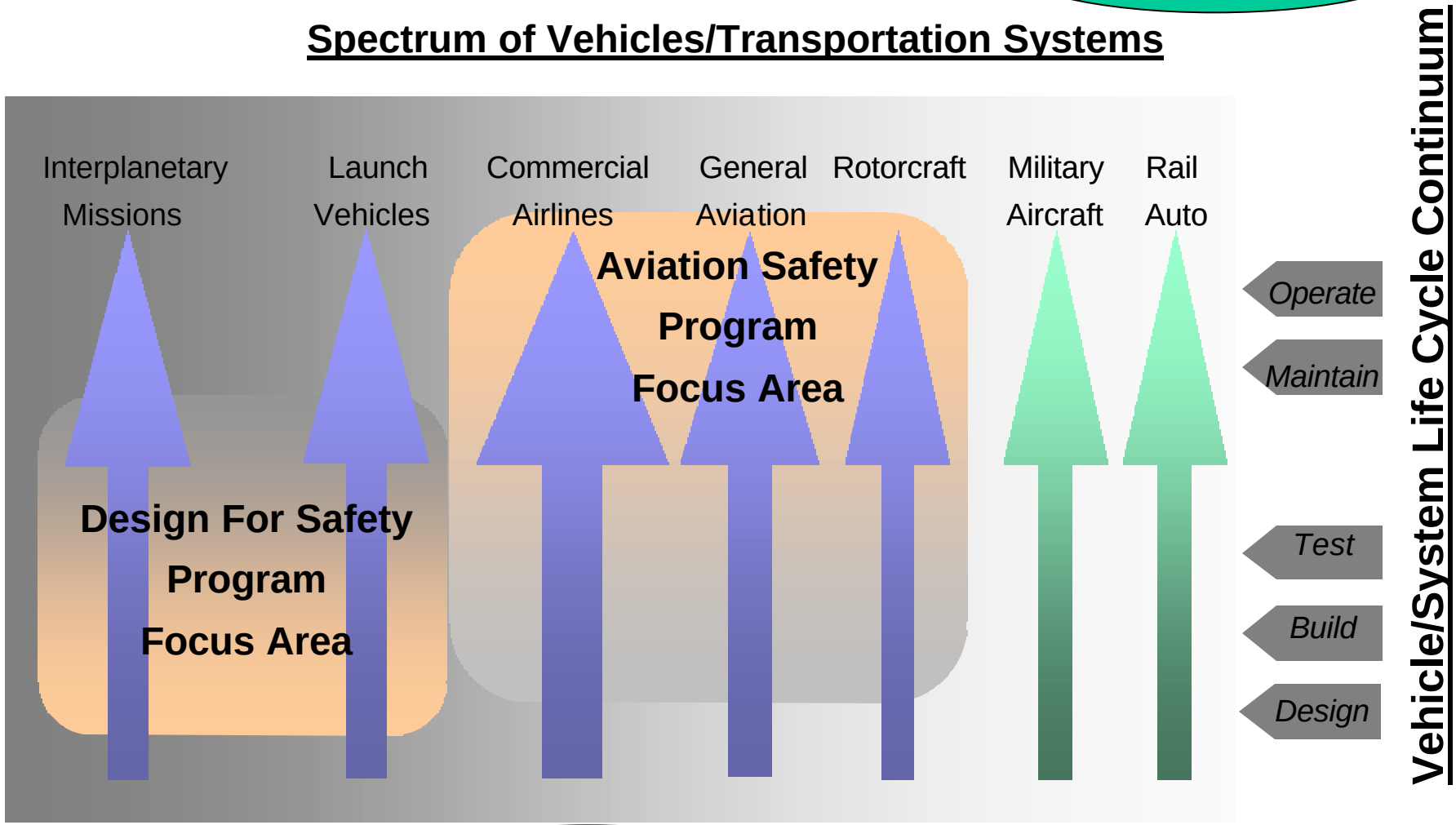
Design for Safety



http://dfs.nasa.gov/

Design for Safety Program and Aviation Safety Program Relationship

PRELIMINARY



PRELIMINARY

Coordination, Cooperation, Partnerships

Aviation Safety Plans

- NASA AvSP Program Plan
- FAA/NASA Integrated Safety Plan
- National Research and Development Plan for Safety, Security, Efficiency and Environmental Compatibility

National Science and Technology Council

http://www.volpe.dot.gov/resref/strtplns/nstc/aviatrd/index.html

National Aviation Safety Agenda

- Industry/Government Coordination
- Adopted for the implementation of FAA “Safer Skies*”

	Commercial Aviation Safety Team (CAST)	General Aviation Joint Steering Committee (GAJSC)
Joint Safety Analysis Teams (JSAT)	•AIA •Airbus •ALPA •APA •ATA •Boeing •FSF •P&W* •RAA •IATA •DOD •FAA - Aircraft Cert - Flight Standards - System Safety - Air Traffic Ops - Research •NASA •ICAO •JAA *Representing GE and RR	•AOPA •EAA •GAMA •HAI •NATA •NBAA •FAA - Aircraft Cert - Flight Standards - System Safety - Air Traffic Ops - Research •NASA
Joint Safety Implementation Teams (JSIT)		

* http://www.faa.gov/avr/news/previous/Safskies.htm

Wire Systems Safety Interagency Working Group

- Focal point for wire safety technology in the US
- Responsible for timely coordination and communication of federal research to improve safety for air, space, and other areas where aging wiring is a safety issue
- Currently soliciting from the US industry and academia existing S&T initiatives that will detect or predict wire deterioration leading to adverse safety and health effects - inputs by 8/28/00 to chuettne@ostp.eop.gov

External Relations

- FAA/Industry relations consistently building
  - AIR, ARA, ASY, Air Traffic, AFS
  - Wx MOA signed
  - CAST, GAJSC
  - AvSPEC
  - Safeflight 21, Runway Incursion Initiative
- International strategy
  - Use where can help program, tap into capabilities, be careful of tech transfer (ASMM/TI relations with NLR good examples)
  - Safety information is openly shared at the concept level

Future Opportunities

Opportunities - from current efforts

- New information on accident causes stemming from new and ongoing accident investigations
- Outgrowths, or extensions, of the concepts demonstrating the most promising results from the initial investments

Opportunities - from improved flight data analysis

Discovery of new accident & precursor causal factors

- Aircraft Parameter Monitoring System
- Flight Operations Quality Assurance
- Performance Data Analysis and Reporting System
- Improved flight data collection
  - Higher data rates
  - Video
  - Back-up power supply for recorders
  - …

Opportunities - from expanded and improving professional observation results

- Aviation Safety Reporting System
- Global Aviation Information Network
- National Aviation Operations Monitoring Service
- Aviation Safety Action Program
  - An ALPA initiative sanctioned by FAA

Opportunities - from below the cut line of the original ASIST Process

Accident Prevention Investment Areas

30 Design Techniques for High-Integrity Complex Digital Systems
31 Rotorcraft-specific Procedures and Training
32 Structural Configurations and Aging Airframes/Engines
33 Organizational Culture for Safety
34 Safety & information security of flight operations in future NAS
35 Wake Vortex Hazard Avoidance
36 Procedures Design Methods
37 Design to support Teamwork
38 Weather Hazard Characterization
39 Cowl Fire Monitoring/Suppressant Techniques in Post-Halon Era
40 Maintenance Training
41 Runway Contamination
42 Maintenance Task Procedures
43 Design to support Performance Readiness

http://www.aero-space.nasa.gov/library/asist/res_doc.htm

Opportunities - from recent NRC report

Aviation Safety and Pilot Control, National Research Council, 1997

- This NRC report followed a three year study focused solely on a single technical aspect of aviation safety – the aircraft-pilot coupling (APC) problem
- Aircraft-Pilot Coupling is a potentially catastrophic phenomena resulting in momentary lose of control of the aircraft
- With current flight data recorders, an accident involving an APC will go undetected
- The “Findings and Recommendations” of this report are not currently being addressed

http://www.nap.edu/books/0309056888/html/index.html

Concluding observations & comments

NTSB's Most Wanted Transportation Safety Improvements

Airport Runway Incursions

Provide for safer control of aircraft on the ground.

Airframe Structural Icing

Revise icing criteria and certification testing requirements.

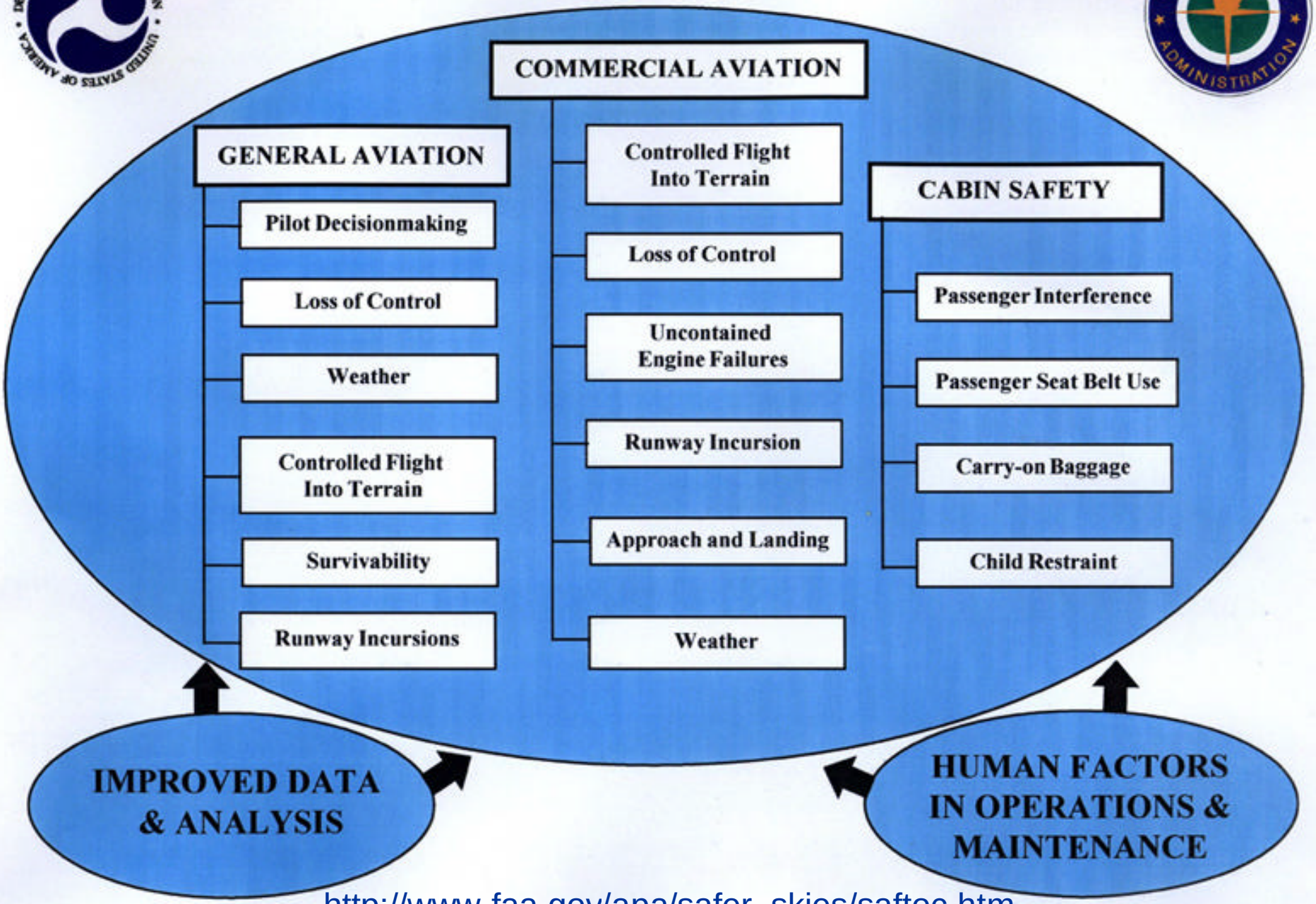
Research and develop on-board aircraft ice protection and detection systems.

Explosive Mixtures in Fuel Tanks on Transport Category Aircraft

Require preclusion of operation of transport category aircraft with explosive fuel-air mixture in fuel tanks

http://www.ntsb.gov/recs/aviation_issues.htm

SAFER SKIES - A FOCUSED AGENDA



http://www.faa.gov/apa/safer_skies/saftoc.htm

Concluding observations, 1 of 3

- The Systems Modeling and Monitoring thrust of AvSP is strategically aligned to complement the improved flight data gathering initiatives of NTSB, FAA & Industry, providing increased clarity of current safety issues, and identification of future issues

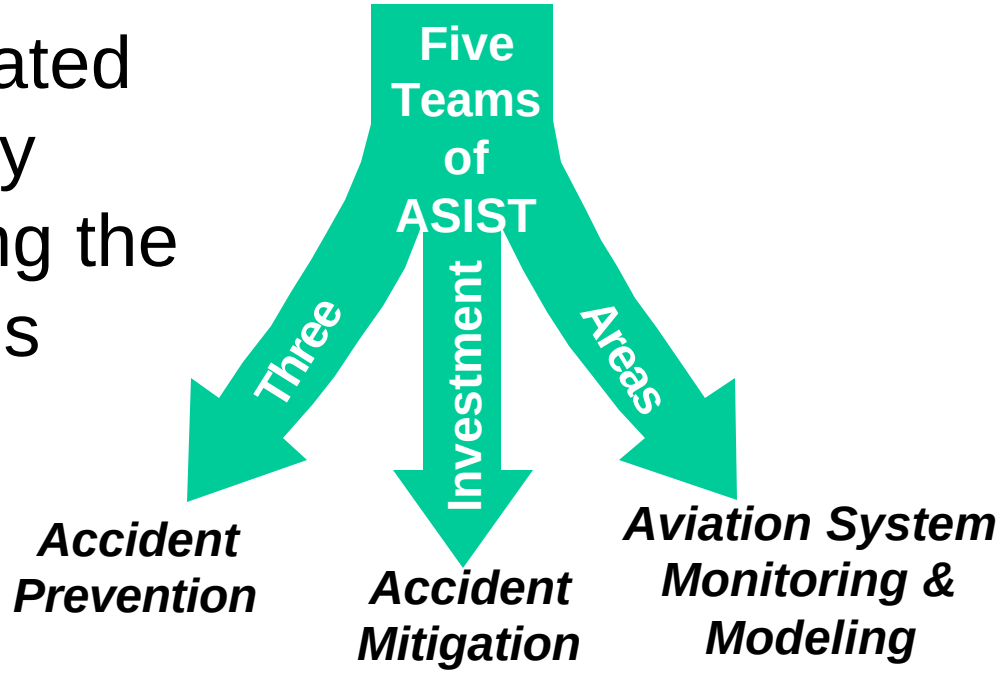
Concluding observations, 2 of 3

- The Accident Prevention thrust of AvSP contains elements directly addressing the two top accident categories[1], LoC and CFIT, as well as the top four primary causal factors[2] (crew, aircraft, maintenance, weather) of worldwide commercial jet accidents.
- Additionally, this thrust address 11 of the 12 safety issues in the FAA's "Safer Skies" initiative for general and commercial aviation

1 Accounting for 53% of the fatal accidents from 1988 thru 1997, Statistical Summary of Commercial Jet Airplane Accidents, Worldwide Operations, 1959-97.
2 Covering 63% of hull loss accidents with from 1988 thru 1997

Concluding observations, 3 of 3

- The Accident Mitigation thrust of AvSP directly addresses the single remaining Safer Skies issue, survivability
- The AvSP resulting from the ASIST process, in concert with the other associated complementary safety activities is addressing the FAA and NTSB needs



Closing comments, 1/2

- Yesterday
  - Aviation Safety was high priority
  - TWA 800, ValuJet 592, WHCSS raised the bar
  - Reprogramming $0.5B for AvSP demonstrated NASA's commitment to help, and legitimized the bar raising
  - ASIST helped bring the aviation safety community closer and build consensus on the issues
  - There was frustration at wanting a "data driven" safety program with recognition that the data just wasn't there

Closing comments, 2/2

Today, the community is continuing to come together

- collectively striving for improved safety
- aggressively pursuing a multi-faceted discovery effort
  - to identifying the missing links in the accident chain and to become “data driven”
  - to be vigilant for new safety threats as our vehicles and traffic systems evolve for tomorrow’s growth
- aggressively pursuing solutions to recognized safety issues
- “blame” is still an inhibiting factor
- “fixing” and “solving” are growing in emphasis

The End

Thank You!

Comments/Questions?

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